Chapter 2 Collisions

In hockey, which player can have the greatest influence on the outcome of a game? Many fans would argue that it's the goaltender. That certainly was the case for Team Canada in the 2002 Winter Olympics in Salt Lake City and in the World Cup of Hockey in 2004. Martin Brodeur played exceptionally well for Canada in both of these tournaments, establishing himself as one of the premiere goaltenders in the world.

It takes an extraordinary person with tremendous athletic ability to stop frozen hockey pucks travelling at speeds in excess of 150 km/h. Doing this safely requires good protective equipment, like the thick leg pads and specialized helmet that utilize the latest high-tech materials.

What factors need to be considered in the design of an effective helmet for a goaltender? Since the helmet must slow down and change the direction of the puck, one consideration would be the concepts related to accelerated motion. Earlier, your work suggested that forces and Newton's laws would need consideration. Another aspect might be related to the overall design and choice of materials to ensure safety while recognizing the need for clear lines of sight, low mass, and ventilation.

In this chapter you will continue your study of how forces affect motion. You will investigate the concepts of momentum, the change in momentum, and the conservation of momentum. These new concepts will allow you to investigate the science of collisions.

Try This Activity

Characteristics of an Object in Motion

Purpose

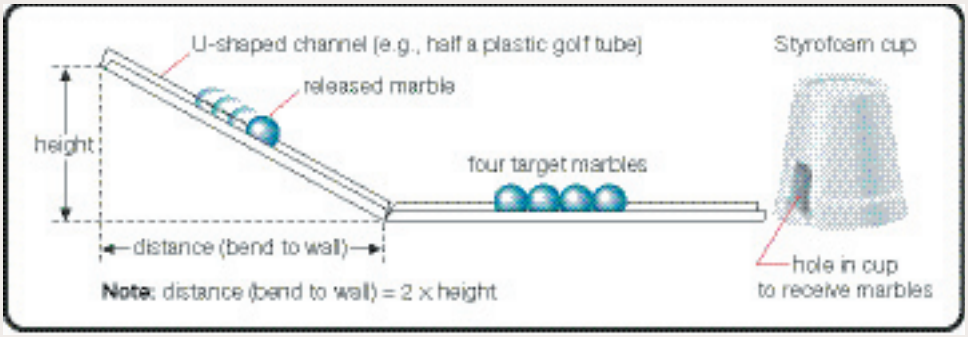
You will identify the most significant characteristics of an object in motion.

Science Skills

- ✓ Performing and Recording
- ✓ Analyzing and Interpreting

Materials

Set up the materials as shown in the following diagram.


U-shaped channel (e.g., half a plastic golf tube)
Styrofoam cup
released marble
height
four target marbles
distance (bend to wall)
hole in cup to receive marbles
Note: distance (bend to wall) = 2 × height

Procedure

step 1: Place four marbles in a row inside the horizontal section of the tube. Make sure the marbles are touching each other.

step 2: Release a single marble from the 10-cm mark on the inclined portion of the tube so that the single marble rolls down the tube and strikes the other marbles. Observe how many marbles on the other side are ejected, and measure how far the Styrofoam cup moves. Record your observations in a table like the one on the right.

step 3: Repeat steps 1 and 2, releasing a single marble from the 20-cm and 30-cm marks.

step 4: Repeat steps 1 to 3, releasing two marbles. Record your observations in the data table.

Number of Marbles Released	Release Point from Bend (cm)	Number of Marbles Ejected After Collision	Distance Cup Moves (cm)
1	10		
1	20		
1	30		
2	10		
2	20		
2	30		

Analysis

1. What characteristic of the released marble is changed by increasing the height?
2. Describe the effect of increasing the height of the released marble on this system.
3. What characteristic changes when the number of released marbles is doubled from one marble to two?
4. Describe the effect of releasing two marbles on this system.

Evaluation

5. Based on your results, identify two significant characteristics of an object in motion.